

FINAL  
REMEDIAL INVESTIGATION

RAYMARK -OU4- BALLFIELD SITE  
STRATFORD, CONNECTICUT

RESPONSE ACTION CONTRACT (RAC), REGION I

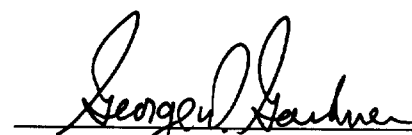
For  
U.S. Environmental Protection Agency

By  
Tetra Tech NUS, Inc.

EPA Contract No. 68-W6-0045  
EPA Work Assignment No. 030-RICO-01H3  
TtNUS Project No. N0004

August 1999

  
Heather M. Ford  
Project Manager

  
George D. Gardner, P.E.  
Program Manager

RAYMARK RI99272F

3.06

18024

**TABLE OF CONTENTS**  
**FINAL REMEDIAL INVESTIGATION**  
**REMEDIAL INVESTIGATION/FEASIBILITY STUDY**  
**RAYMARK OU4 BALLFIELD**  
**STRATFORD, CONNECTICUT**

<u>SECTION</u>	<u>PAGE</u>
<b>1.0 INTRODUCTION .....</b>	<b>1-1</b>
1.1 Purpose of Report .....	1-2
1.2 Report Organization .....	1-2
1.3 Raymark Facility Background .....	1-4
1.3.1 History of Raymark Facility and Environs .....	1-4
1.3.2 Raymark Facility Operating History .....	1-6
1.3.3 Environmental Permits .....	1-10
1.4 Study Area Description and Setting .....	1-12
1.5 Community Description .....	1-15
1.6 Other Activities Associated with Raymark .....	1-15
<b>2.0 STUDY AREA INVESTIGATIONS .....</b>	<b>2-1</b>
2.1 Previous Investigations .....	2-1
2.2 Study Area Investigation Activities and Methods .....	2-2
2.2.1 Geophysical Survey .....	2-2
2.2.2 Geologic Investigation .....	2-3
2.2.3 Hydrogeologic Investigation .....	2-5
2.2.4 Monitoring Well Installation .....	2-6
2.2.5 Groundwater Level Monitoring .....	2-6
2.2.6 Groundwater Sampling .....	2-7
2.2.7 Topographic Survey .....	2-7
<b>3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA .....</b>	<b>3-1</b>
3.1 Study Area Features and Setting .....	3-1
3.2 Geology .....	3-3
3.2.1 Regional Geology .....	3-4
3.2.2 Study Area Geology .....	3-6
3.3 Hydrogeology .....	3-11
3.3.1 Regional Hydrogeology .....	3-11
3.3.2 Study Area Hydrogeology .....	3-12
3.4 Surface Water Hydrology .....	3-13
3.5 Meteorology .....	3-14
<b>4.0 NATURE AND EXTENT OF CONTAMINATION .....</b>	<b>4-1</b>
4.1 Potential Sources of Contamination .....	4-1
4.2 Overview of Chemical Compounds Detected .....	4-2
4.2.1 Volatile Organic Compounds (VOCs) .....	4-2
4.2.2 Semivolatile Organic Compounds (SVOCs) .....	4-2

**TABLE OF CONTENTS (Con't.)**  
**FINAL REMEDIAL INVESTIGATION**  
**REMEDIAL INVESTIGATION/FEASIBILITY STUDY**  
**RAYMARK OU4 BALLFIELD**  
**STRATFORD, CONNECTICUT**

<b><u>SECTION</u></b>	<b><u>PAGE</u></b>
4.2.3 Pesticides .....	4-3
4.2.4 Polychlorinated Biphenyls (PCBs) .....	4-3
4.2.5 Metals .....	4-4
4.2.6 Asbestos.....	4-4
4.2.7 Chemical Compounds Used or Handled at the Raymark Facility .....	4-5
4.2.8 Terminology for Evaluating Analytical Data .....	4-5
4.3 Background Concentrations .....	4-6
4.4 Nature and Extent of Contamination in Soil.....	4-7
4.4.1 VOCs in Soils .....	4-8
4.4.2 SVOCs in Soils .....	4-10
4.4.3 Pesticides in Soils.....	4-11
4.4.4 PCBs in Soils .....	4-12
4.4.5 Metals in Soils .....	4-14
4.4.6 Asbestos in Soils.....	4-20
<b>5.0 CONTAMINANT FATE AND TRANSPORT .....</b>	<b>5-1</b>
5.1 Contaminant Sources and Releases.....	5-1
5.2 Mechanisms and Factors Governing Fate and Transport .....	5-2
5.3 General Fate and Transport Processes of Soil Contaminants .....	5-2
5.3.1 Chemical Properties that Influence Contaminant Fate and Transport .....	5-3
5.3.2 Physical State of Contaminants in Environmental Media .....	5-6
5.4 Contaminant Fate and Transport in Soils at the Ballfield Study Area.....	5-8
5.4.1 VOCs in Soils.....	5-9
5.4.2 SVOCs in Soils.....	5-10
5.4.3 PCBs in Soils .....	5-10
5.4.4 Metals in Soils .....	5-11
5.4.5 Asbestos in Soils.....	5-12
<b>6.0 BASELINE HUMAN HEALTH RISK EVALUATION .....</b>	<b>6-1</b>
6.1 Introduction – Overview of Risk Assessment Process .....	6-1
6.2 Data Evaluation .....	6-3
6.2.1 Selection of Chemicals of Potential Concern .....	6-3
6.2.2 Identification of COPCs .....	6-7
6.2.4 Exposure Point Concentrations .....	6-10
6.3 Exposure Assessment .....	6-12
6.3.1 Exposure Setting.....	6-12

**TABLE OF CONTENTS (Con't.)**  
**FINAL REMEDIAL INVESTIGATION**  
**REMEDIAL INVESTIGATION/FEASIBILITY STUDY**  
**RAYMARK OU4 BALLFIELD**  
**STRATFORD, CONNECTICUT**

<u><b>SECTION</b></u>	<u><b>PAGE</b></u>
6.3.2 Conceptual Site Model.....	6-16
6.3.3 Potential Routes of Exposure.....	6-18
6.3.4 Potential Receptors .....	6-20
6.3.5 Exposure Pathways.....	6-24
6.3.6 Quantification of Exposure .....	6-25
6.3.7 Exposure to Lead .....	6-28
6.4 Toxicity Assessment.....	6-29
6.4.1 Noncarcinogenic Effects .....	6-31
6.4.2 Carcinogenic Effects .....	6-33
6.4.3 Toxicity Summaries for Major Chemicals of Concern .....	6-35
6.5 Risk Characterization.....	6-39
6.5.1 Risk Characterization Methodology .....	6-39
6.5.2 Risk Characterization Results .....	6-40
6.6 Uncertainties Analysis.....	6-44
6.6.1 Uncertainty in Selection of Chemicals of Concern.....	6-46
6.6.2 Uncertainty in the Exposure Assessment.....	6-47
6.6.3 Uncertainty in the Toxicological Evaluation .....	6-49
6.7 Summary of Human Health Risk Assessment.....	6-52
6.7.1 Noncarcinogenic Risks.....	6-53
6.7.2 Carcinogenic Risks .....	6-53
6.7.3 Exposure to Lead .....	6-53
6.7.4 Exposure to Asbestos.....	6-54
<b>7.0 ECOLOGICAL EVALUATION.....</b>	<b>7-1</b>
7.1 Characteristics of the Study Area .....	7-1
7.2 Ecological Setting .....	7-2
7.2.1 Wildlife .....	7-3
7.2.2 Mammals.....	7-3
7.2.3 Birds.....	7-4
7.2.4 Reptiles .....	7-4
7.3 Conclusions .....	7-4
<b>8.0 SUMMARY AND CONCLUSIONS.....</b>	<b>8-1</b>
8.1 Nature and Extent of Contamination Summary.....	8-2
8.1.1 Nature of the Contamination .....	8-2
8.1.2 Extent of Contamination .....	8-2
8.1.3 Volatile Organic Compounds (VOCs) .....	8-3
8.1.4 Semivolatile Organic Compounds (SVOCs).....	8-3
8.1.5 Pesticides .....	8-4

**TABLE OF CONTENTS (Con't.)**  
**FINAL REMEDIAL INVESTIGATION**  
**REMEDIAL INVESTIGATION/FEASIBILITY STUDY**  
**RAYMARK OU4 BALLFIELD**  
**STRATFORD, CONNECTICUT**

<u>SECTION</u>	<u>PAGE</u>
8.1.6 Polychlorinated Biphenyls (PCBs) .....	8-5
8.1.7 Metals .....	8-6
8.1.8 Asbestos.....	8-7
8.2 Contaminant Fate and Transport Summary .....	8-8
8.3 Risk Assessment Summary .....	8-8
8.3.1 Human Health Risk Assessment .....	8-8
8.3.2 Ecological Risk Evaluation .....	8-9
8.4 Conclusions .....	8-9

**TABLES**

**NUMBER**

4-1	Chemical Compounds used or handled at the Raymark Facility
4-2	Summary Statistics for Background Soil Samples
4-3	Summary Statistics for Detected Compounds – Surface Soils (0' – 2' bgs)
4-4	Summary Statistics for Detected Compounds – Subsurface Soils (> 2' bgs)
6-1	Summary of Remedial Investigations and Recommendations
7-1	Ecological Evaluation

**FIGURES**

**NUMBER**

1-1	Site Locus
1-2	Study Area
2-1	Field Investigation Locations
3-1	Cross Section Locations
3-2	Cross Sections
3-3	Estimated Thickness of Fill
3-4	Bedrock Surface Topography
3-5	Water Table Elevation (March 24, 1999) Contour Map
4-1a	Total PAH Concentrations (0 ft – 2 ft bgs)
4-1b	Total PAH Concentrations (> 2 ft bgs)
4-2a	Total PCB Concentrations (0 ft to 2 ft bgs)
4-2b	Total PCB Concentrations (> 2 ft bgs)
4-3a	Lead Concentrations (0 ft – 2 ft bgs)
4-3b	Lead Concentrations (> 2 ft bgs)
4-4a	Arsenic Concentrations (0 ft – 2 ft bgs)

**TABLE OF CONTENTS (Con't.)**  
**FINAL REMEDIAL INVESTIGATION**  
**REMEDIAL INVESTIGATION/FEASIBILITY STUDY**  
**RAYMARK OU4 BALLFIELD**  
**STRATFORD, CONNECTICUT**

**FIGURES (Con't.)**

**NUMBER**

4-4b	Arsenic Concentrations (> 2 ft bgs)
4-5a	Barium Concentrations (0 ft – 2 ft bgs)
4-5b	Barium Concentrations (> 2 ft bgs)
4-6a	Zinc Concentrations (0 ft – 2 ft bgs)
4-6b	Zinc Concentrations (> 2 ft bgs)
4-7a	Copper Concentrations (0 ft – 2 ft bgs)
4-7b	Copper Concentrations (> 2 ft bgs)
4-8a	Chromium Concentrations (0 ft – 2 ft bgs)
4-8b	Chromium Concentrations (> 2 ft bgs)
4-9a	Asbestos Concentrations (0 ft – 2 ft bgs)
4-9b	Asbestos Concentrations (> 2 ft bgs)

**REFERENCES**

**APPENDICES**

Appendix A	Geophysical Survey Report
Appendix B	Geologic Logs
Appendix C	Analytical Data
Appendix D	Human Health Risk Assessment
Appendix E	Aerial Photographs

## ACRONYMS AND ABBREVIATIONS USED IN THE REMEDIAL INVESTIGATION REORT

ARARs	Applicable or Relevant and Appropriate Requirements
AWQC	Ambient Water Quality Criteria
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
B&RE	Brown & Root Environmental
BSL	Below Screening Level
BTU	British Thermal Unit
°C	degree Celsius
CAA	Clean Air Act
CERCLA	The Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Amended by SARA in 1986. Also called the Superfund Law.
cf	cubic foot
CFR	Code of Federal Regulations
CLP	(EPA) Contract Laboratory Program
cm	centimeter
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CSF	Cancer Slope Factor
CT DEC	Connecticut Direct Exposure Criteria
CT DEP	Connecticut Department of Environmental Protection
CT PMC	Connecticut Pollutant Mobility Criteria
CTE	Central Tendency Exposure
CWA	Clean Water Act
CY	cubic yard
DABS	Dermal Absorption Factors
DAS	Delivery of Analytical Services
DDT	Dichloro diphenyl trichloroethane
dia	diameter
DNAPL	dense non-aqueous phase liquid
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
°F	degree Fahrenheit
FEMA	Federal Emergency Management Agency
FS	Feasibility Study
ft	foot
ft <sup>2</sup> /day	square foot per day
ft <sup>3</sup> /day	cubic foot per day
g	gram
GA/GAA	State of Connecticut Classification for drinking water sources
GB	State of Connecticut classification for non-drinking water sources
gpd	gallon per day
gpm	gallon per minute

GPR	Ground Penetrating Radar
GPS	Global Positioning System
GRA	General Response Actions
HBC	Housatonic Boat Club
HHRA	Human Health Risk Assessment
HI	Hazard Index
HNUS	Halliburton NUS Corporation
hr	hour
HQ	Hazard Quotient
IDW	Investigation-Derived Waste
IEUBK	EPA's Integrated Exposure Uptake and Biokinetic Model for lead exposure
ILCR	Incremental Lifetime Cancer Risk
in.	inch
K	Hydraulic conductivity
Kd	Adsorption coefficient
kg	kilogram
l	liter
lb	pound
LDR	land disposal restriction
m	meter
μ	micro (prefix)
μg/dL	micrograms per deciliter
μg/kg	microgram per kilogram
μg/l or μg/L	microgram per liter
MCL	Federal Safe Drinking Water Act maximum contaminant level. The primary MCL is health-based; the secondary is aesthetic-based.
MCLG	Federal Safe Drinking Water Act maximum contaminant level goal.
mg	milligram
mg/kg	milligram per kilogram
mg/l or mg/L	milligram per liter
mi	mile
ml	milliliter
MOA	Memorandum of Agreement
mph	miles per hour
MSL	mean sea level
NCP	National Oil and Hazardous Substances Contingency Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOAA	National Oceanic Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPW	Net Present Worth
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
OSWER	(EPA's) Office of Solid Waste and Emergency Response
OU2	Operable Unit No. 2
OU3	Operable Unit No. 3



PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
POTW	Publicly-Owned Treatment Works
ppb	part per billion
PPE	personal protective equipment
ppm	part per million
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
psi	pound per square inch
PVC	polyvinyl chloride
QA/QC	Quality Control/Quality Assurance
RAC	Response Action Contract
RAO	Remedial Action Objective
Raymark Facility	Raymark Industries, Inc. Facility
RCRA	Resource Conservation and Recovery Act
Removal Action	Action taken by EPA to address immediate danger to public health and the environment
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	(EPA's) Record of Decision. Documents the selection of a cost-effective Superfund remedy.
RSRs	State of Connecticut Remediation Standard Regulations
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act of 1986. Amended CERCLA. Also known as the Superfund law.
SB/SC	State of Connecticut Classification for Coastal and Marine Surface Water
SDWA	State Drinking Water Act
SPLP	Synthetic Precipitation Leaching Procedure
sf	square foot
SSL	Soil Screening Level
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TBC	To Be Considered
TCDD	2,3,7,8 – tetrachlorodibenzo-p-dioxin
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TEF	Toxicity Equivalence Factor
TEQ	Toxicity Equivalency
TPH	Total Petroleum Hydrocarbons
TSDF	(RCRA) Treatment, Storage, and Disposal Facility
TtNUS	Tetra Tech NUS, Inc.
UCL	Upper Confidence Limit
USACE	U.S. Army Corps of Engineers

USCS  
USDOI  
USGS  
VOC  
Weston

Unified Soils Classification System  
U.S. Department of the Interior  
U.S. Geological Survey  
Volatile Organic Compound  
Roy F. Weston, Inc.

## 1.0 INTRODUCTION

This Remedial Investigation (RI) Report defines the nature and extent of contamination at the Raymark Ballfield site (the Study Area) resulting from past disposal practices at the Raymark Industries, Inc. Facility (Raymark Facility), located in Stratford, Fairfield County, Connecticut (Figure 1-1). This report was prepared by Tetra Tech NUS, Inc. (TtNUS) for the U.S. Environmental Protection Agency (EPA) under RAC Work Assignment No. 030-RICO-01H3, Contract No. 68-W6-0045, to partially fulfill the requirements for Operable Unit No. 4 (OU4), Raymark - Ballfield.

As requested by EPA, this report incorporates information collected by another EPA contractor in 1992 and 1993 with data collected under this work assignment. Information collected by the Connecticut Department of Environmental Protection (CT DEP) will be used qualitatively only. This RI Report was developed based on the approved Draft Final Work Plan dated February 1999. Additional efforts to evaluate groundwater contamination beneath and downgradient of the ballfield property are currently being conducted by TtNUS under Raymark-Operable Unit No. 2 (OU2 groundwater), RAC Work Assignment No. 029-RICO-01H3.

This RI Report was prepared in accordance with the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988). It is consistent with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986; and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This RI maintains consistency with the State of Connecticut's applicable and relevant environmental laws and regulations.

## **1.1            Purpose of Report**

This RI Report documents the nature and extent of contamination, and associated public health and environmental risks within the ballfield property (see Figure 1-2 for identification of the Study Area). The overall objectives of the RI are to:

- Compile and evaluate all available data needed to characterize the Study Area conditions and to determine the nature and extent of contamination in the soil impacted by waste from the Raymark Facility.
- Assess the risks to human health and the environment within the soil of the Study Area.
- Serve as the data resource for developing, screening, and evaluating a range of potential alternative remedial actions that address the contamination within the Study Area. The RI supports the remedial alternatives screening and the Feasibility Study (FS).

## **1.2            Report Organization**

This RI Report is comprised of one volume that presents the text and discussion of investigation activities, results, interpretations, and references. The tables, figures (including oversize figures), and the appendices are presented as separate tab sections at the end of the document. Appendix A includes the results of the geophysical survey; Appendix B contains the boring, test pit, and well construction logs; Appendix C contains the analytical data used to produce this RI report; Appendix D contains the backup tables and calculations for the Human Health Risk Assessment; Appendix E contains a series of historical aerial photographs.

This RI Report is organized as follows:

- Section 1.0, Introduction, discusses the purpose and scope of the RI, summarizes the background and history, and describes the Study Area.
- Section 2.0, Study Area Investigations, presents a summary of the previous field investigation activities conducted in the Study Area.
- Section 3.0, Physical Characteristics of the Study Area, presents descriptions of surface features and land uses, geology, hydrogeology, surface water hydrology, and meteorology.
- Section 4.0, Nature and Extent of Contamination, discusses the potential sources, contaminant presence, and contaminant distribution in soils in the Study Area.
- Section 5.0, Contaminant Fate and Transport, presents an interpretation of potential contaminant migration pathways and transport mechanisms.
- Section 6.0, Baseline Human Health Risk Assessment, includes identification of human receptors and exposure pathways, selection of contaminants of concern (COCs), discussion of the human health effects associated with the COCs, and results of the human health risk evaluation.
- Section 7.0, Ecological Evaluation, presents a summary of the environmental setting and identifies areas of potential ecological concern.
- Section 8.0, Summary and Conclusions, details the summary of Section 4.0, 5.0, 6.0, and 7.0 and the conclusions reached about the contaminated areas.

### **1.3            Raymark Facility Background**

This section summarizes the history of the Raymark Facility, summarizes the past operations at the Raymark Facility, summarizes the Raymark Facility environmental permits, describes the Study Area, and identifies other ongoing activities associated with the Raymark Facility and its environs.

#### **1.3.1            History of Raymark Facility and Environs**

The Raymark Facility, formerly named Raybestos - Manhattan Company, was located at 75 East Main Street in Stratford, Fairfield County, Connecticut at latitude 41°12'02.5"N and longitude 73°07'14.0"W (see Figure 1-2). The Raymark Facility operated from 1919 until 1989, when the plant was shut down and permanently closed. The Raymark Facility produced and manufactured parts mainly for the automotive industry. The manufacturing of these products generated waste. The facility was demolished and a cap was placed over the contaminated areas on the property in 1996 and 1997. The facility occupied 33.4 acres (based on Stratford tax map information), and manufactured friction materials containing asbestos and non-asbestos components, metals, phenol-formaldehyde resins, and various adhesives. Primary products were gasket material; sheet packing; and friction materials including clutch facings, transmission plates, and brake linings. As a result of these activities, soils at the facility became contaminated primarily with asbestos, lead, and polychlorinated biphenyl compounds (PCBs).

Between 1919 and 1984, low-lying portions of the Raymark Facility were filled with manufacturing waste materials from various plant operations. The filling of those areas occurred over the life of the facility operations, and progressed essentially from north to south, across the Raymark Facility. New buildings and parking areas were constructed over these filled areas as the manufacturing facility expanded.

The Raymark Facility was underlain by an extensive drainage system network. This network collected water and wastes from the manufacturing operations and diverted it into

the facility drainage system. The system also collected stormwater runoff. These liquids were transported through the drainage system network, mixed with lagoon wastewaters, and discharged to Ferry Creek.

During peak operations at the Raymark Facility, approximately two million gallons of water were used for plant processes each day. Municipal water was used for both contact and non-contact cooling water. To supplement this source, Raymark installed an additional on-site supply well. The well, located in the northern corner of the facility, was used for non-contact cooling water. Facility water was recirculated, with some percentage reinjected into the on-site well; the remaining water and municipal water were discharged through the facility drainage system. Wastewater from facility operations was collected and discharged to a series of four settling lagoons located in the southwestern corner of the facility, and along the southern property boundary near Longbrook Avenue and the Barnum Avenue Cutoff. The wastewater consisted of wastewater from the acid treatment plant, wet dust collection, and paper making processes; non-contact cooling water; and solvent recovery plant operations. The lagoons also received stormwater drainage and surface water runoff.

Solids were allowed to settle in Lagoon Nos. 1, 2, and 3 prior to discharge of clarified wastewater and unsettled solids to Lagoon No. 4, that in turn discharged directly into Ferry Creek. Discharge of wastewater to Lagoon Nos. 1, 2, and 3 ceased in 1984. These lagoons were closed in December 1992 and January 1993. During the fall of 1994, stormwater drainage that exited the Raymark Facility through Lagoon No. 4 was diverted around this lagoon and connected directly to the storm drain, which ultimately discharges to Ferry Creek. Lagoon No. 4 was closed in early 1995.

During the operation of the lagoons, the settled material in the lagoons was periodically removed by dredging. During the facility's 70 years of operation, it was common practice to dispose of both this dredged lagoon waste and other manufacturing waste as "fill" material (referred to as "Raymark-type waste" in this RI) both at the Raymark Facility and

at various locations in Stratford. The ballfield Study Area is one of the locations that received Raymark-type waste.

A number of these off-the-facility "locations," with levels of asbestos, lead, and PCBs that posed a potential threat to public health, were remediated under EPA CERCLA time-critical removal actions during 1993 to 1996. The remediated locations are residential properties that were designated a health threat and excavated under EPA direction to abate the public health threat that may have existed. The excavated material from these residential locations was stored and ultimately placed under the cap at the Raymark Facility. Waste from one municipal property, Wooster Middle School, was also excavated, stored and ultimately placed under the cap at the Raymark Facility.

### **1.3.2 Raymark Facility Operating History**

The following narrative presents a summary of plant operations and waste handling practices for Raymark's manufacturing operations; see OU1 RI (HNUS, 1995) for further details.

#### **1.3.2.1 Phenolic Resin Manufacturing**

Solid and liquid phenolic resin was manufactured at the Raymark Facility. The resin was produced in five or six pressure vessels; companion tanks held the raw product. After production, the liquid resins were transferred to the plant floor to be used to manufacture plant goods or to set in order to be used in solid form. Prior to use, the solid resins were pulverized on site to meet product specifications, and then transferred to the plant floor for use.

#### **1.3.2.2 Brake Lining Production**

Brake lining production began by adding dry asbestos materials, liquid phenolic resins, and solvents (to thin the resins) to the mixers located on the plant floor. The mixers operated



for approximately one hour until the liquid resin had penetrated and coated all the dry materials. This mixture, resembling a soft heavy mud, was formed into brake lining parts that were then baked in ovens for 6 hours. The end product was a hard material that was machined to specification. As necessary, materials that were trimmed and ground during the machining operations and not used in the finished product were disposed of on or off site as fill/soil-waste material; after 1984, these process wastes were shipped off site in containers.

During the machining operations, waste particulates were collected in a wet-type dust collection system. Particulates collected from the system were mixed with process water and pumped to the on-site lagoons as a 90/10 water/dust slurry mixture. The slurry mixture settled out in the lagoons and eventually filled them. When a lagoon was filled, the slurry mixture would be diverted to another lagoon, to allow time (several months) to dewater. The dewatered material in the lagoon was excavated and disposed of either on site or off site. After 1984, the waste particulates were collected in dry dust collectors and disposed of off site in 1-cubic yard bags.

#### 1.3.2.3 Standard Transmission Clutch Plates

The process of producing clutch plates began by creating a mixture of asbestos, other components, and water and forming a paper-like sheet of material. This sheet was rolled onto a machine roller, saturated with phenolic resin, and then oven dried and cured. The clutch plates were machined to specifications from these sheets and the finished clutch plate was bonded to a steel core. As in the brake lining production, the manufacturing process produced machining particulates that were collected in the dust collection system, mixed into a wet slurry, and pumped to the lagoons to settle. This system was replaced in 1984 by the dry dust collectors.

In the early 1980s, the process was modified to allow water to be reused and captured into the manufacturing process, resulting in no discharge of water. In addition, the dry

asbestos used in the original manufacturing of the paper-like material was replaced with a cotton-type material, so the product became asbestos-free.

The Raymark Facility molded (raw) steel into a steel core onto which the clutch plate was mounted. After molding, the steel core was degreased, etched to specification, coated with a phenolic resin, and allowed to dry. The clutch plate was then mounted to the steel core.

A specialty heavy-duty clutch was also manufactured on the Raymark Facility. The process of mixing the asbestos, resins, and water to produce heavy-duty clutches was similar to that used to produce the standard transmission clutch plates.

#### 1.3.2.4 Gasket Material Manufacturing

Gasket material was produced in large rubber sheets. The rubber was composed of naphtha, toluene, asbestos, phenolic resins, and various fillers. The process began by mixing asbestos, latex, rubber cement, and rubber together until the mix was homogeneous. The mix was then loaded onto a roller machine, where it was flattened into a sheet. The sheet was removed and laid out on a large table for cutting. The gaskets were then cut to specification.

The trim from cutting was pulverized and re-used in the process. Vapors were collected and passed through the activated carbon solvent recovery plant. Prior to the mid-1980s, no vapor collection/treatment occurred.

#### 1.3.2.5 Disc Brake Pad Manufacturing Operations

Asbestos, glass, and semi-metallic disc brakes were manufactured at the Raymark Facility. Asbestos disc brakes were composed of asbestos, phenolic resin, and fillers; glass disc brakes, of fiberglass, phenolic resin, and fillers; and semi-metallic disc brakes, of steel wool, phenolic resin, and fillers. The operations to process these disc brake pads involved

mixing components in plant mixers until a homogenous mixture was coated completely with phenolic saturate, pouring the mixture into electronically heated molds to form a hard part, and machining this part into the specified product size.

Waste generated from the machining process was collected in the dust collector system, and transported as described above, as a water/waste slurry mixture, to the on-site lagoons. After 1984, dry dust collectors collected the particulate matter and the material was disposed of off site in 1-cubic yard bags. The trim and off-specification material, if not pulverized for reuse, was disposed of as fill.

#### 1.3.2.6 Miscellaneous Activities

The following activities also occurred on the Raymark Facility:

- Coal-fired Steam Generation - The Raymark Facility generated steam from August 1919 until the early 1940s. Steam was generated from coal-fired steam boilers. The coal was delivered by rail directly onto the facility by a railroad spur that has since been removed. The coal was stored in the area surrounding the boiler house and heavy equipment moved it around the plant. No figures are available on the quantities of coal used.
- Steam boilers - The steam boilers were converted to oil in the early 1940s. Number 6 fuel oil was stored in two 50,000 gallon tanks. No figures are available on quantities of oil used.
- Material storage - Numerous tanks, located throughout the plant, stored raw product, manufactured goods not yet turned into a product, and waste products remaining from the various manufacturing processes.
- Dry trim reclamation - The materials that were trimmed from the baked products (dry trim) were stored outside under a roof on the asphalt pavement. The trim

re-use process consisted of using hammer mills to pulverize the waste trim. As dry trim re-use occurred more frequently during later years of facility operations, particulates from this process were collected in a separate dry dust collector system and bagged for disposal.

- Finished products - These materials were stored on site pending off-site shipment to customers.

### **1.3.3 Environmental Permits**

The Raymark Facility was subject to the requirements of both state and federal permits.

#### **1.3.3.1 RCRA Activities**

Raymark filed a Notification of Hazardous Waste Activity form on August 15, 1980, under the name of Raybestos Friction Materials Company. The activities delineated on this form indicated that the company generated, treated, stored, and disposed of hazardous wastes such as chlorinated solvents, acetone, formaldehyde, toluene, sludge from lime treatment generated from steel finishing operations, asbestos, acids, phenols, methyl ethyl ketone, and ignitable, corrosive, and toxic wastes.

On November 12, 1980, the notification was expanded to include the activities and quantities listed below for each waste activity. However, the quantities listed below were the total permitted quantities and not the actual quantities or units reportedly used at Raymark.

- The Raymark Facility was permitted to process more than 2.5 billion gallons of lead-contaminated waste liquid each year in the on-site lagoons. It is estimated that 6 million gallons of the 2.5 billion gallons were treated each year.

- The Raymark Facility container storage area was permitted to handle approximately 23 million gallons of toxic, ignitable, corrosive, and acidic wastes each year.
- The Raymark Facility tank storage area was permitted to handle approximately 10 million gallons of waste yearly.
- The Raymark Facility incinerator was permitted to process approximately 240,000 gallons per year of toxic and ignitable wastes.

In 1986, Raymark filed a permit application for the various Raymark Facility activities under the name of Raymark Industries, Inc. At that time, the original RCRA Part A notification was re-filed and the on-site activities and waste generated were significantly reduced. The activities described in that submittal included 7,040 gallons of liquid container waste, 150 cubic yards of solid container waste stored on the property, and an approximately 7-acre landfill on the property. The "landfill" was comprised of the lagoons previously located along the southern boundary of the Raymark Facility. Each of these activities appeared to include the handling of ignitable, toxic, corrosive, and toluene-contaminated wastes.

The facility closed in September 1989. In 1990, pursuant to a RCRA 3007 information request, Raymark indicated it still had significant quantities of waste and unused products remaining on site. Some of these waste products were 400,000 gallons of an asbestos slurry in tanks and 1,700 cubic yards of unfinished asbestos product. These wastes were removed from the Raymark Facility between 1990 - 1994.

In 1992, EPA issued Raymark a CERCLA 106 Removal Order and work plan designed to abate the danger or threat to public health and welfare, and the environment posed by four open lagoons containing asbestos, metals, solvents, and PCBs; a hazardous waste pile; buildings and land containing hazardous substances; and large tanks of questionable integrity containing asbestos and hazardous substances; and to eliminate the potential for hazardous substances to migrate off site.

Three of the open lagoons were temporarily closed in December 1992 and January 1993 under the EPA order. The fourth lagoon was temporarily closed in 1994. In 1993, on-site storm water was rerouted around Lagoon No. 4 so the storm water no longer discharged into Lagoon No. 4. The facility cleanup/remediation was conducted under the CERCLA program, and the on-site sources (lagoons, tanks, incinerator) have been removed and/or remediated as part of the long-term solution.

#### **1.3.3.2      Wastewater Activities**

The Raymark Facility had a 2.5 million gallon per day water and wastewater discharge flow from the plant operations into the lagoons for discharge into Ferry Creek. This discharge was permitted under the State of Connecticut National Pollution Discharge Elimination System (NPDES) program from the early 1970s until the early 1990s, with volumes decreasing as plant activities were reduced. The activities permitted included: acid treatment plant wastewater, dust collection system wastewater, noncontact cooling water, and solvent recovery plant wastewater. A separate permit was issued for an extraction well, which was installed on site to remove groundwater contaminated with toluene from the aquifer and discharge it to the sanitary sewer. The toluene contamination was the result of a spill that occurred on site in 1984.

### **1.4              Study Area Description and Setting**

The Study Area, which is located north of the former Raymark Facility, encompasses a total area of 13.5 acres and includes the 3-acre Raybestos Memorial Ballfield, an 8.5-acre vacant field, and a 2-acre densely wooded area. Residential properties border the north/northwest side of the Study Area along Clinton Avenue. Town, commercial, and industrial properties are located along Frog Pond Lane to the Northeast. Railroad tracks and the former Raymark Facility border the Study Area to the east/southeast. An inactive industrial property abuts the Study Area to the south/southwest.

The Study Area boundary line seen on each figure defines the horizontal limits of the data points used for this RI. The boundary line mimics the security fence line surrounding the OU4 property that was installed as part of an interim remedial effort performed by the EPA in 1992. There are two areas where the Study Area boundary line extends beyond the perimeter fencing and covers portions of the abutting property. One of these locations is situated along the southern border abutting the Contract Plating Property, indicated on Figure 1-2, where two test pits were extended into the neighboring property to attempt to locate the horizontal extent of fill. The second area where the Study Area boundary line exceeds the perimeter fencing is along the eastern border parallel to the railroad tracks where Roy F. Weston collected surficial soils samples for the EPA in 1992 and 1993.

The information in this section is based on data from previous site investigations, removal action reports, and aerial photographs taken in 1940, 1949, 1960, 1971, and 1990. The aerial photographs from 1940, 1949, 1960, 1971, and the most recent 1999 photograph is included in Appendix E.

Aerial photographs indicate that the Raybestos Memorial Field was built between 1940 and 1949. The ballfield area was used as a softball field for the Raybestos women's softball team from the 1940s until the 1980s. The Study Area still contains the bleachers, fencing, lighting, parking area, and playing field outline that was used during team play.

The vacant area outside the ballfield was used as a source of sand and gravel in the 1940s. A large pond (Frog Pond) is visible in the 1940 photograph and is located in the southern portion of the field. Apparent pond filling occurred in the years that followed, since the pond appears to significantly diminish in size through the 1949 and 1960 aerial photographs. Frog Pond appears to have been almost completely filled by the 1971 photograph and does not appear to be present in the 1990 aerial photograph.

Evaluation of test borings and analytical data indicates that the pond was filled with Raymark-type waste materials. It is unclear whether Frog Pond was formed as a result of excavation activities associated with the sand and gravel operations mentioned above. A

peat layer approximately 2.5 feet thick was encountered in the area of the pond during test borings. This peat could be indicative of the pond's existence prior to excavation activities. The pond was likely formed in association with regional deglaciation. It appears the historical pond (1940s) outlet drained south toward the railroad tracks and eventually discharged to Long Brook or Ferry Creek.

A review of previous consultants' evaluations of the ballfield area indicates that prior to development as a ballfield, the site was used as a gravel pit operation for an unknown period of time and was then used to dispose of brake linings and associated industrial waste. The former Raymark Industries Inc. company disposed of an unknown quantity of wastes containing asbestos and non-asbestos material, metals, pheno-formaldehyde resins, and various adhesives on this Study Area. Between 1940 and 1949, the site was graded and the northern corner of the property was developed as a softball field (ES&E, Inc., July 1991).

The southern and western portions of the Study Area were used by the Town of Stratford as a dumping and temporary storage area for asphalt, road salt, brush and leaves, dirt, and trash. Because of the easy access to the site, the public also used this area as a dump. Jugs of dumped waste oil were noted near the piles of brush and leaves. Additionally, Metro North Railroad tracks located near the dumping area are noted as a potential source of creosote. Creosote and similar substances may have been used as a preservative for the railroad ties (EAI, Inc., July 1990).

In the 1970s, Raymark Industries, Inc. performed two cleanup activities to place a 2-foot soil cover over identified areas of surficial asbestos contamination. The Study Area was purchased by the Daley Development Corporation (Daley) of Stratford, Connecticut, in 1986.

In 1989, EPA conducted a preliminary assessment of the Study Area. In 1990, EPA issued an Administrative Order for Removal Action to the Daley Development Corporation. In 1992, as a result of Daley's failure to implement the removal action, EPA assumed



responsibility for site actions. The removal action implemented by EPA included installing a site security fence, clearing vegetation that would interfere with cap/cover placement, grading and capping areas of the site with clean soil (6 inch minimum cover), and sampling and removing on-site drums. Soil sampling profiles collected after completion of the cover indicate the soil cover ranges in thickness from approximately 6 to 11 inches (EPA, 1992). Other site investigations were performed during the period from 1988 through 1992 (soil borings, soil sampling, test pits); however, these activities appear to have had little impact on site habitat or topographic features.

### **1.5            Community Description**

The principal industries within the Stratford community include manufacturing of aircraft, air conditioning, chemicals, plastic, paper, rubber goods, electrical and machine parts, and toys. The Stratford Town Clerk reported the latest (1997) estimate for the population of the Town of Stratford as 47,230 people within the 19.9 square miles (12,736 acres) of the town. This is a decrease from the last census in 1990 when the population was listed as 49,389.

### **1.6            Other Activities Associated with Raymark**

Activities undertaken in the vicinity of the Study Area that are related to the investigations conducted to support this RI include:

- Raymark Facility Closure - The property has been capped by EPA under the U.S. Army Corps of Engineers Total Environmental Restoration Contract (TERC). A soil vapor extraction system is in place to capture the bulk of the toluene remaining under the cap, and a dense non-aqueous phase liquid (DNAPL) extraction system is removing separate phase NAPL (predominantly 1,1,1-trichloroethane [1,1,1-TCA]), which is collected in the sump portion of the wells. Operation and maintenance activities are being conducted by the CT DEP. The effects of the pump and treat system on groundwater quality are unknown at this time.

- Groundwater Remedial Investigation Activities - TtNUS is undertaking an RI for Raymark – OU2 to evaluate groundwater contamination under and downgradient of the former Raymark Facility. The OU2 RI is being conducted concurrently with this OU4 RI work assignment. A Technical Memorandum for OU2 presenting preliminary results of the 1997 field efforts was submitted to EPA in May 1998.

A substantial number of field investigations relating to soil, sediment, surface water, and groundwater have been conducted at the Raymark Facility and its environs. A list of the major activities conducted to date was provided on Table 1-1 in the Ferry Creek – OU3, Area I RI (TtNUS, 1999).

## 2.0 STUDY AREA INVESTIGATIONS

This section describes investigations performed to characterize the impacts on the Study Area resulting from past disposal of waste materials. A figure showing current Study Area conditions is presented as Figure 1-2.

Investigations performed at the Raymark Facility are summarized in the Final Remedial Investigation Report, (HNUS, 1995). Evaluation of groundwater contamination beneath and migrating downgradient of the Study Area, the Raymark Facility and surrounding properties is currently being summarized in a Remedial Investigation/Feasibility Study Report under Raymark – Operable Unit No. 2 groundwater, RAC W. A. No. 029-RICO-01H3. Investigation of properties potentially impacted by Raymark Facility wastes have been conducted since 1992. This information is detailed in chronological order in the Draft Ferry Creek – OU3, Area I Remedial Investigation (TtNUS, 1999). Development of RI Reports for commercial and industrial properties located around the Raymark Facility are being conducted under separate work assignments (W.A. 35 and W.A. 42). These RIs and the groundwater RI are planned to be available for public review during 1999.

### 2.1 Previous Investigations

The EPA, CT DEP, and the current property owner, Daley Development, have conducted investigations at the Study Area. The EPA Emergency Planning and Response Branch conducted the first investigation in 1989. In 1990, Environmental Assurance, Inc. conducted a follow-up investigation on behalf of the property owner, Daley Development. In 1991, the EPA and CT DEP conducted an additional investigation documented in a report titled, Supplementary Site Assessment at Raybestos Memorial Field, (Environmental Science and Engineering, Inc., 1991). The analytical results from these studies are not included in this RI Report because sample locations could not be verified and data were not validated. On behalf of EPA, Weston prepared a report titled, After Action Report for the Raybestos Memorial Field Site Stratford, Connecticut, dated 1992. It documents actions taken by the EPA, Emergency Planning and Response Branch to mitigate the threat to public health resulting from actual or potential exposure to nearby human populations.

The actions taken at the site included installing a fence and placing a minimum 6-inch vegetative cover. In 1993, EPA conducted soil sampling at many areas in Stratford including the Raybestos Memorial Ball Field (Weston, 1994). These data were used to supplement the data gathered during this RI Investigation. See Figure 2-1 for the location of all samples used in this RI. Since completion of the older investigations, the site has been graded and covered with a temporary soil cap to limit potential exposure to the site contaminants.

## **2.2            Study Area Investigation Activities and Methods**

This section describes the most recent activities conducted by TtNUS for this Remedial Investigation. The investigation activities performed at the Study Area include a geophysical survey, geologic investigation, hydrogeologic investigation, monitoring well installation, groundwater level monitoring, groundwater sampling, and topographic survey. A brief discussion of the objective and rationale for each activity is presented. See Figure 2-1 for these field investigation locations.

### **2.2.1            Geophysical Survey**

A geophysical survey using electromagnetic (EM) and ground penetrating radar (GPR) was performed by Hager Richter Geoscience as a subcontractor to TtNUS. The purpose of the survey was to determine the presence, location, and character of wastes disposed as fill, including the location of potential buried vessels and subsurface utilities. This information was used to select soil boring locations and to develop estimates of the fill thickness in the Study Area. Thickness of fill in the Study Area is discussed in Section 3.2.

The geophysical surveys were conducted in a phased approach. The first phase was a 1-day field test to determine whether the EM and GPR were able to meet the investigation objective of identifying the thickness of the waste. This first phase was also used to evaluate optimum transmitter frequency and evaluate line spacing and other survey parameters. The second phase consisted of the full survey of the Study Area using the EM and GPR techniques.

A review of previous investigations and aerial photographs was conducted to select a location for the 1-day field test. This review involved estimating the location of the historic Frog Pond and the areas of thicker fill. Results of the geophysical survey are provided in Appendix A.

### **2.2.2 Geologic Investigation**

The geologic investigation consisted of advancing soil borings and excavating test pits throughout the Study Area. Soil and bedrock samples from these explorations were used to provide data on the type, thickness, and lateral extent of the fill and geologic materials at the property.

The geologic investigation activities included advancing 14 soil borings, (SB-421 – SB-430, and MW-401S, MW-401B, MW-402S, and MW402B), installing two monitoring well clusters (MW-401 and 402) consisting of both an overburden and bedrock well, and excavating 22 test pits. The boring procedures are fully described in the Technical Specification Drilling Services presented in the Sampling and Analysis Plan (TtNUS, 1998). Locations are indicated on Figure 2-1. The 14 soil borings were used to supplement data concerning the nature and extent of the fill materials gathered from the test pit excavations. The borings also add vertical definition of the overall geologic conditions found at the Study Area. Ten of the 14 borings (SB-401B, SB-402B, SB-421 through SB-427, and SB-429) were advanced to the top of the bedrock surface and cored into the bedrock to confirm bedrock presence and provide data on the nature and depth to bedrock. The locations of SB-424, 425, 426, and 427 were selected based on the geophysical surveys, which identified areas of potentially thicker waste/fill. SB-428 and SB-430 were only advanced to 16 feet below ground surface (bgs) to fill gaps in test pit data concerning the extent of fill. These two locations were not used to define bedrock topography. The locations of SB-429 and SB-422 were selected to confirm the nature and depth of bedrock in the vicinity of Test Pits 20 and 22 where bedrock was encountered at a shallow depth.

Continuous soil samples were collected through the waste material using 3-inch outside diameter, 2-foot long split-barrel samplers. Soil samples were collected by driving the split-barrel sampler into the subsurface ahead of the drilling casing, using a procedure similar to that described in ASTM D-1586-84, Split-Barrel Sampling, except for use of a 3-inch outside diameter split-barrel and a 300-pound hammer with an 18-inch fall.

Beneath the waste materials, soil samples were collected at 5-foot intervals using a 2-inch outside diameter split-barrel sampler. The soil sampler was advanced as described in ASTM D-1586-84, Split-Barrel Sampling. Completed borings logs are presented in Appendix B.

Soil samples collected for laboratory analysis are biased toward higher concentrations because their selection was based on the highest photoionization detector (PID) and flame ionization detector (FID) readings detected in each borehole. Samples were collected from both waste and natural materials. Details of the soil sampling procedure are presented in the SAP.

Eighty-one soil samples were collected from the ballfield borings for off-site analysis for the presence of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), and metals. The VOC samples were preserved immediately after collection and were analyzed using the low concentration procedure. Details of the soil VOC sampling and preservation methods are presented in the SAP. Sixty-four samples were analyzed for asbestos at an off-site laboratory.

Six soil samples (including one duplicate) were collected for grain size analysis. The samples collected were selected to complement other grain size soil sampling tasks that were being performed under the OU2 groundwater investigation. The samples were selected to provide grain size data for both coarse and fine-grained soils that were encountered in both the OU4 and OU2 Study Areas.

Five soil samples (including one duplicate) were collected for analysis of total organic carbon (TOC). The samples were selected to complement both the OU4 and OU2 groundwater Study Area investigations.

Bedrock borings were advanced through the overburden material as described above. Bedrock was cored at each soil boring and monitoring well cluster location.

The depth of bedrock coring was determined after a review of the recovered bedrock core and the objectives of the boring. One of the objectives of the soil borings was to confirm the top of bedrock. Typically coring was completed to a depth of 5-feet below the top of the bedrock at soil boring locations. The actual depth of bedrock coring was determined in the field by the project geologist after a review of the recovered rock core.

The objective of installing the bedrock monitoring wells was to provide a location capable of responding to seasonal changes in groundwater elevation and to sample groundwater from the bedrock aquifer. The actual depth of bedrock coring was determined in the field by the project geologist after a review of the recovered rock core and observations of water loss during the drilling process. If the packer tests results indicated that the bedrock would not produce water at an acceptable rate, the bedrock boring was advanced deeper.

Twenty-two test pits were excavated at the Study Area. These test pits were located along the perimeter of the Study Area, along the outfield fence, and in the outfield area to provide data to estimate the extent of the fill and waste materials. In addition, these test pits provided information on the thickness and type of waste materials at the property.

### **2.2.3 Hydrogeologic Investigation**

A complete hydrogeologic investigation of the Study Area is not part of the scope of this RI. However, a limited discussion of the groundwater conditions observed during the OU4 RI investigation is presented. This discussion is intended to provide a more complete picture of Study Area conditions. The extent of the hydrogeologic discussion will include

a water table map and an estimate of the volume of waste materials that are located below the water table (see Section 3.3).

#### **2.2.4 Monitoring Well Installation**

Monitoring well clusters were installed at two locations on the Study Area. Each cluster consists of one water-table overburden well and one bedrock well. All wells were constructed using schedule 40 PVC and were completed with a locking protective steel casing. Details of the well installations were recorded on monitoring well installation forms and are presented in Appendix B. The monitoring wells were constructed to supply data on groundwater elevations, hydraulic conductivity, vertical gradients, and groundwater quality that could be used for both the OU4 and OU2 RIs. These data will be used to determine if this area represents a groundwater recharge area and determine the groundwater quality. Data from these wells and other wells installed as part of the OU2 groundwater investigation and the OU1 Post Closure monitoring will be used to construct a water table map for the Ballfield Site. The water table elevation data from these wells supports an evaluation of remedial options.

The monitoring wells were developed after installation to remove fine particles and sediments from around the well screens, and to remove drill cuttings and residual drilling fluids from the monitored interval. The field geologist/engineer recorded observations such as turbidity and specific conductivity on a well development log. The well development logs are presented in Appendix B.

The hydraulic conductivity of both the overburden and bedrock aquifers was measured during this site investigation. The field methods used included a constant head discharge test method and packer testing for the overburden and bedrock, respectively.

#### **2.2.5 Groundwater Level Monitoring**

A round of groundwater levels was conducted throughout the entire OU2 Study Area including the ballfield during an approximate 4-hour period on March 24, 1999. The



depths to groundwater and other pertinent observations were recorded on groundwater monitoring log sheets. These data were used to construct the water table contour figure (see Section 3.3).

#### **2.2.6 Groundwater Sampling**

The monitoring wells were purged and sampled using the low stress (Low Flow) methodology. Groundwater samples were labeled and packed as described in the SAP and shipped for off-site laboratory for analysis. Detailed field sampling procedures are presented in Section 2.0 of the Sampling and Analysis Plan, TtNUS, 1999.

Groundwater samples were collected and sent to an off-site laboratory for analysis of Target Compound List (TCL) VOCs, SVOCs, pesticides/PCBs (including Aroclors 1262 and 1268), Target Analyte List (TAL) metals, sulfate, chloride, total alkalinity, and nitrate/nitrite. In addition, samples from all wells were analyzed for natural attenuation parameters including carbon dioxide, ferrous iron, nitrite, sulfide, methane, ethane, and ethene.

#### **2.2.7 Topographic Survey**

A Connecticut-licensed surveyor was contracted to determine the coordinates and elevation of each monitoring well, soil boring, geophysical survey point, and test pit. In addition, a topographic survey of the Study Area was conducted. The topographic survey included locating physical features such as buildings, bleachers, fences, and other pertinent features. The elevation datum of the survey is the U.S. Geological Survey (NGVD 1929).

### **3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA**

This section summarizes regional and Study Area physical characteristics. The Study Area features and land uses are described in Section 3.1. Discussions of related geology, hydrogeology, surface water hydrology, and meteorology are presented in Sections 3.2 through 3.5, respectively.

#### **3.1 Study Area Features and Setting**

The Study Area is part of the Housatonic River Basin, a tidally influenced system. The Study Area is bordered by private residences, commercial/industrial properties, roadways, and active railroad tracks (Figure 1-2). The Housatonic River is located approximately 2,000 feet to the east. A complete description of the Study Area and history is included in Section 1.4.

The majority of the Study Area is relatively level, with a steep topographic rise along the western extreme, and to a lesser degree to the north and south. The overall impression of the Study Area topography is an irregular shallow depression with a wide flat bottom. Bedrock outcrops are exposed at numerous locations along the steep rise at the western property boundary.

In addition to the monitoring wells, soil borings, and test pits located within the Study Area, five monitoring well locations were selected outside of the Study Area boundary. These locations were selected to better define the on-site bedrock topography and the water table (see Figure 2-1). Data from two monitoring well clusters (MW-308B&DB and MW-216B&BD) were used as upgradient/background locations for the OU4 Study Area. Data from three monitoring well clusters (MW-309S, D, and B; PC-06S, M, D, and B; and PC-10S, M, D and B) were selected for use as downgradient locations for the OU4 Study Area.

The Study Area is located outside of the 100-year floodplain, as observed from Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps for Stratford, Connecticut (FEMA, 1992). The 100-year frequency base flood elevation is 10.1 feet National Geodetic Vertical Datum (NGVD); the 10-year frequency flood elevation is 8.5 feet NGVD (USACE, 1998). The majority of the Study Area lies at topographic elevations of approximately 14 to 16 feet NGVD 1929, but rises to a maximum elevation of 48 feet along the western edge of the Study Area.

As discussed in greater detail Section 7.0, no state or federally listed threatened or endangered flora or fauna were identified in the Study Area.

The Study Area encompasses a total area of approximately 13.5 acres, and includes the 3-acre Raybestos Memorial Ball Field, an 8.5-acre vacant field, and a 2-acre densely wooded area. A chain-link security fence that surrounds the property restricts Study Area access. There are two vacant buildings, concrete and steel bleacher seats, and two dugouts in the vicinity of the baseball diamond, along the northern edge of the Study Area. A double row of chain-link fence defines the outfield limits of the ballfield. Numerous flagpoles and utility/light poles are located between these two sets of fencing, with additional utility/light poles scattered throughout the Study Area. Many of these utility poles still have remnant wiring and lighting fixtures attached, although the wiring has been cut in place. The overall condition of the Study Area facilities is poor, due to a lack of maintenance. Asbestos warning signs are posted along the security fencing.

The Study Area is inactive except for a small paved area located in the eastern corner of the Study Area that is used by a construction company. This area is used to store construction and landscaping supplies, tractor-trailer bodies, and miscellaneous recreational items such as campers and boats. Numerous small piles of woody debris and general refuse are also present.

Residential properties border the north/northwest side of the Study Area on Patterson and Clinton Avenues. Town, commercial, and industrial properties including the Stratford

Department of Public Works office and garage are located on Frog Pond Lane to the northeast. State of Connecticut, Department of Transportation railroad tracks and the former Raymark Facility border the Study Area to the east/southeast. An inactive industrial property abuts the Study Area to the south/southwest.

Subsurface Study Area features include a 48-inch reinforced concrete sewer line entering the Study Area near the access gate off of Frog Pond Lane. The sewer line had a grade of 0.05 percent at a depth of approximately 5 feet below grade at the time of construction. The sewer line extends through the southeastern portion of the Study Area, parallel to the fence line, approximately 600 feet from Frog Pond Lane and then crosses beneath the adjacent rail lines. The current depth of the sewer line is unknown due to the history of dumping at the site and the subsequent re-grading and capping activities. Potential buried utilities were also identified during the geophysical survey of the Study Area. The results of the geophysical survey are discussed in Section 3.2.2 and are included in Appendix A. Other subsurface features located during test pit activities include an 8-inch diameter corrugated steel drainpipe surrounded with ¾-inch crushed stone, as encountered at test pit 3 near the outfield fence. A buried electrical line was also exposed during the excavation of test pit 21 in the ballfield outfield. All soil boring, test pit, and monitoring well locations are shown on Figure 2-1. Additional detail concerning these features can be found on the test pit logs in Appendix B.

### **3.2            Geology**

This section provides a brief overview of the geology of the region, as well as that of the OU4 Study Area. A more detailed evaluation of the surrounding area, including additional geologic/hydrogeologic data, and additional geologic cross-sections, groundwater contour maps, and bedrock surface contour maps will be presented in the OU2 groundwater RI (W.A. No. 029). The description of the Study Area geology is a general discussion of soils (natural deposits and artificial fill deposits) and bedrock as encountered in Study Area borings and test pits, with an emphasis on surficial soils. For the purposes of this report, fill is included within the category of soil.

### 3.2.1 Regional Geology

The discussion of the regional geology is based on published reports and is a summary of the regional geology discussion from the *Final Remedial Investigation Report, Raymark Industries, Inc. Facility* (HNUS, 1995). Discussion of the regional geology is divided into two subsections: overburden and bedrock. The overburden is defined as the unconsolidated deposits of sand, silt, gravel, clay, and peat. The overburden is underlain by bedrock consisting of the metamorphic rock types schist and gneiss.

#### 3.2.1.1 Regional Overburden Geology

Connecticut has been covered by glacial ice at least twice in geologic time. During the last glacial retreat, glaciers deposited a thin, discontinuous mantle of till overlying bedrock. Glacio-fluvial outwash deposits formed thicker, highly stratified sequences of silty sand to gravelly sand, overlying till, and filling bedrock valleys. Windblown sand and silt were also deposited on valley floors, however, these deposits are indistinguishable from present day organic topsoil deposits.

The Study Area is generally located in the Stratford outwash plain, on the western Housatonic River valley floor. Natural overburden deposits in the vicinity of Stratford consist of glacial deposits (outwash sediments, ice-contact stratified drift, and till) and recent swamp and marsh deposits.

**Glacial till**, deposited by glacial ice, is variable in thickness, forming a discontinuous mantle over bedrock. The till consists of a non-stratified, poorly sorted mixture of coarse (gravel/cobbles/boulders) and fine (sand/silt/clay) fractions, with the coarse fraction generally not exceeding 20 percent.

**Ice-contact stratified drift** includes mixtures of sand, gravel, silt, and clay, which is frequently poorly sorted with abrupt changes in grain size. These deposits were formed

during glaciation in streams and local ephemeral lakes in close relation to melting glacier ice, and often grade into outwash sediments.

**Glacial outwash deposits** are predominant in the stream valleys, and consist of highly stratified sand, silty sand, and gravelly sand. Beds are not persistent, and individual lenses attain thicknesses of tens of feet, and thin out or are truncated over short distances. Outwash units in the vicinity of the Study Area generally consist primarily of sands with up to 50 percent gravel, grading up-valley (northward).

**Swamp and marsh deposits** are present in lowlands, depressions, and in proximity to the Housatonic River. Tidal marshes are also present in this area. Swamp and marsh deposits consist of silt, sand, and clay-sized particles interbedded with organic fragments and peat deposits. The oldest marshes in the western coastal area of Connecticut (2,000 to 4,000 years old) have peat deposits of approximately 10 feet.

#### 3.2.1.2 Regional Bedrock Geology

According to the "Bedrock Geological Map of Connecticut" (CT GNHS, 1985) the Study Area is located in the Connecticut Valley Synclinorium of Connecticut's Western Uplands. The regional bedrock setting consists of a series of meta-sedimentary and meta-volcanic rocks of the Early and Middle Paleozoic Age, generally foliated, with foliation trending northeast-southwest, in a large syncline. These rocks are mainly schists and gneisses. The sequence was tightly folded and subjected to progressive regional metamorphism, ranging from chlorite to kyanite grade. A high angle fault is mapped approximately 1 mile to the southeast of the Study Area, across the Housatonic River, generally trending southwest to northeast. The implication of this fault and any related splay faulting to local geology and contaminant transport was not evaluated.

Outcrops of bedrock occur within the Study Area along the western edge of the property. Bedrock outcrops were also observed and surveyed at numerous locations outside of, but surrounding the Study Area. A bedrock ridge appears to control local topography, and a

portion of the ridge forms the rise along the western edge of the Study Area. This ridge measures approximately ½ mile in length, trends northeast to southwest, with multiple outcrops.

### **3.2.2 Study Area Geology**

The geology of the Study Area is divided into two subsections: overburden (surficial) and bedrock. The discussion of the Study Area geology is based on overburden and bedrock data collected during soil boring and test pit activities conducted during field investigations, as summarized in Section 2.0.

#### **3.2.2.1 Study Area Overburden Geology and Fill Thickness**

The overburden deposits that occur within the shallow subsurface of the Study Area are mapped as Stratford outwash sediments and fill deposits (Flint, 1968). Based on borings advanced and test pits excavated in the Study Area by TtNUS, the surficial sediment deposits are characterized primarily by a variety of locally derived glacial outwash deposits, ice contact deposits, alluvial deposits, swamp and marsh deposits, and fill materials. The deposited sediments consist of silt, sand, and gravel, and range from silt with trace clay, to sands and coarse gravels. Swamp and/or marsh deposits in the form of peat/organic silt deposits were identified only at one location, SB-425, underlying fill materials. At boring SB-422, cobbles and boulders were encountered, in addition to sand and gravel, but these coarse materials may be related to the past sand and gravel removal activities. Based on existing data, glacial till has not been identified in the Study Area.

The Study Area overburden geology discussed below is based on boring and test pit data from investigations conducted by TtNUS, as summarized in Section 2.0. For discussion purposes only, a series of geologic profiles (cross-sections) were constructed using the available data collected from the borings and test pits advanced within the Study Area. Figure 3-1 indicates the locations of the four cross-sections and the individual data points included in each. The four cross-sections are shown on Figure 3-2. The purpose of these

profiles is to present the vertical distribution of fill at the Study Area and to indicate the geologic setting of the Study Area. These cross-sections were located within the Study Area at locations where data indicated the thickest fill material. The thickness of fill and the contacts between geologic materials between borings is an interpretation. The actual contacts may vary from those presented. The cross-section contacts were generated using a compilation of the boring and test pit logs, as well as the contour lines created from these same logs for bedrock topography, fill thickness, and water table elevations. The surface elevation data are based on the survey conducted as part of the RI field investigation.

The description of overburden geologic materials presented below is based on soil borings and test pits that were advanced in the Study Area by TtNUS in 1998 and 1999, as part of the RI (described in Section 2). These boring and test pit locations are presented on Figure 2-1 (field investigation locations) and the logs included are in Appendix B. In general, overburden thickness increases as the depth to bedrock increases, from west to east across the Study Area.

Overburden thickness varies from 0 feet where bedrock outcrops at the surface to a maximum depth of 62 feet below grade at SB-423.

The peat/silt horizon, identified at only one location (SB-425), was underlain by sands with varying amounts of silt, gravel, and clay-sized particles, as detailed in the boring logs.

Fill consists of both natural and artificial materials placed as a result of human activity. Fill materials frequently include manufacturing, household, and construction debris, usually mixed with natural materials such as silty sand and gravel. Fill was identified by visual descriptions of soil and sediment samples collected during the field investigations. An estimated thickness of fill map (Figure 3-3) was created based on these descriptions. The estimated thickness-of-fill map was prepared for the Study Area where sufficient data were collected to allow reasonable estimations of thickness of fill across the area



(Figure 3-3). It is assumed that fill thickness varies uniformly between data points, however, the actual thickness of fill between data points may be different than depicted.

Fill consists of a mixture of natural and man-made materials. Natural materials include various amounts of clay, silt, sand, and gravel. Man-made materials consist of asphalt, metal, brick, glass, plastic, and other miscellaneous man-made materials, including manufacturing debris. Other fill materials that do not contain visual evidence of man-made debris are present throughout the Study Area, generally consisting of sands with varying amounts of silt and gravel. This fill is frequently more difficult to distinguish from natural/native deposits, but it is included on the fill thickness map (Figure 3-3). Specific information on the presence or absence of artificial fill material and contaminated soil intervals was determined from the borings and test pit logs prepared during the OU4 field investigation (Appendix B). From the site history discussed in Section 1.3.4, it is known that the surface of portions of the Study Area was re-graded as part of the remedial action taken by the EPA. Approximately 6-11 inches of clean cover fill was placed over much of the Study Area following the grading operations. Because of this capping activity and the obvious construction and modifications that had to occur at the ballfield and paved lot portions of the Study Area, it was assumed that fill covered the surface of the Study Area, except possibly the western corner of the property.

Fill thickness identified in borings and test pits varied from depths of less than 1.0 foot (TP-15) to 17.5 feet below ground surface (SB-427), as indicated in Figure 3-3. Fill thickness in the Study Area generally increases toward the southern portion of the property in the approximate area of the former Frog Pond where the fill is in contact with peat and organic silts that likely formed the former pond bottom. The fill appears to be in direct contact with the bedrock surface at locations such as SB-421 and SB-427, while at many locations such as SB-424 and 426, the fill overlies outwash and ice-contact sands and silt.

Fill materials generally consist of varying amounts of sand, silt, and gravel, with artificial fill materials intermixed at many locations, including "sludge, brake pads, gasket materials,

and asbestos fibers” observed. Some larger man-made debris was noted in the test pits, such as a crushed drum and other smaller containers in TP-7, located near the perimeter fence abutting the Contract Plating property. At SB-421, a strong solvent odor was noted immediately after drilling through a piece of steel, which may have been another drum. The individual test pit and boring logs found in Appendix B provide additional details.

The integrated interpretation of the EM and GPR geophysical data collected at the Study Area (as discussed in Section 2.0) generally confirms the findings of the intrusive investigations. The geophysical report and figures summarizing the findings are supplied as Appendix A. While the purpose of the geophysical survey was to aid in selecting soil boring and monitoring well locations, these data are also useful for confirming areas of more conductive material interpreted as fill, areas of thickest fill (filled depressions), potential areas containing buried metal (possible drums), and buried utilities.

#### 3.2.2.2 Study Area Bedrock Geology

This section provides a detailed evaluation of the Study Area bedrock geology that is based on the review of referenced geologic maps and logs for 12 borings advanced within the Study Area, 5 borings surrounding the Study Area, and 4 of the 22 test pits from the Study Area where bedrock was encountered.

Bedrock elevations from these locations were used to create a bedrock surface topography Figure (3-4). Bedrock outcrops added detail for the bedrock contours in the western portion of the property. Two boring locations (SB-428 and SB-430) did not come in contact with bedrock and were not used for this figure.

Bedrock outcrops are located within the Study Area along the western edge of the property. The elevation of the top of bedrock as observed at sample locations varies 91.4 feet at the Study Area. The highest elevation of the bedrock surface (as observed at sample locations) is approximately 42.3 feet NGVD (3.5 feet below grade) at TP-16, located along the western edge of the Study Area. The lowest elevation of the top of

bedrock, as observed at SB-423 is -49.1 feet NGVD (62 feet below grade), located in the northeast portion of Study Area. The bedrock surface elevation data from the bedrock borings indicates that the top of bedrock slopes from the western exposures downward to the east across the Study Area.

Bedrock underlying the Study Area is mapped as the Derby Hill Schist, a mainly medium- to fine-grained, thinly laminated, greenish-gray to medium dark-gray chloritic muscovite schist, which is Lower to Middle Ordovician in age. This formation may contain minor bands of quartz-rich paragneiss. This rock type is composed mainly of quartz, muscovite, chlorite, and sodium plagioclase, with accessory minerals (Fritts, 1965). As described in Fritts, the bedrock cores from within the Study Area were typically described as foliated, quartz-rich, chlorite-mica-schist with variable amounts of garnet and sulfide minerals such as pyrite. Typically, the bedrock is medium-grained, and usually dark green or dark gray. Veins composed of both quartz and calcite were frequently observed. In most (if not all) coring runs, high-angle schistosity and foliation were observed to be common; weathered fractures ranging from low-angle or horizontal up to high-angle and vertical were also noted. Many of the fractures noted were oriented parallel to foliation planes. Another rock type found underlying the Study Area at SB-422 was a fine- to medium-grained granofels, composed primarily of quartz and feldspar. This light- to medium-gray rock was in gradational contact with the underlying paragneiss or schist at this location. At SB-424, the gneiss showed abundant smokey-quartz veining with pyrite mineralization. In addition to the bedrock fractures, areas of secondary porosity were noted, i.e., vugs or pitting, especially in or along the calcite-rich areas and veins.

In summary, the subsurface materials found at the Study Area are divided into two units, the overburden and the bedrock. The bedrock was found to be highly variable both in topographic relief and composition. The bedrock topography controls the vertical extent of the overburden materials. As seen in the cross-sections (Figure 3-2) and bedrock surface topography (Figure 3-4), the bedrock is exposed at or near the ground surface along the western edge of the property and forms a topographic rise where there is limited overburden material. As bedrock slopes downward to the east, overburden thickness

increases to more than 60 feet below grade. The majority of the overburden materials within the Study Area are natural glacial outwash, ice contact deposits, and alluvial deposits composed mostly of sands and gravels. There is a minor peat and organic silt that may correlate with the former Frog Pond located in the southern portion of the property (see A-A' and C-C', Figure 3-2). The remainder of the overburden materials are considered fill, consisting of man-made material including manufacturing waste, metal, and concrete, as well as re-worked natural materials such as sand and gravel. The surficial material covering the majority of the Study Area consists of natural fill materials used to reduce exposure potential to the underlying fill.

### **3.3        Hydrogeology**

This section provides a brief description of the regional and Study Area hydrogeology; a more detailed discussion of hydrogeology will be presented in the OU2 Groundwater RI, (W.A. No. 029-RICO-01H3), which focuses on groundwater under, and in the vicinity of, the former Raymark Facility.

#### **3.3.1        Regional Hydrogeology**

Regional hydrogeologic units consist of unconsolidated overburden deposits, including till, stratified outwash, swamp and marsh deposits, and an upper fractured bedrock unit. Regional groundwater flow direction is generally toward the Housatonic River (HNUS, 1995).

Groundwater in the vicinity of the Study Area is classified as GB (unsuitable for drinking without treatment) by the CT DEP. The Town of Stratford public drinking water is supplied primarily by the Bridgeport Hydraulic Company. The source of the public drinking water is Trapp Falls Reservoir in Shelton, Connecticut, located approximately 5 miles north of the Study Area. The remainder of the drinking water is supplied by private drinking water wells within Stratford, none of which are known to exist near the Study Area.

### **3.3.2 Study Area Hydrogeology**

This section presents an overview of the Study Area hydrogeology. Groundwater is currently being investigated as part of the OU2 Groundwater RI. A more detailed presentation and evaluation of the hydrogeologic data will be presented in the OU2 Groundwater RI.

The hydrogeology of the Study Area is complex because of the presence of a wide variety of unconsolidated overburden materials and fractured bedrock. The water table, as seen in Figure 3-5, is located in the shallow bedrock along the western edge of the Study Area and crosses into the overburden materials toward the east. Another factor in the potential complexity of the Study Area hydrogeology is the presence of the former Frog Pond bottom sediments that may act as an impermeable or a semi-impermeable barrier where present.

As summarized in Section 3-2, the Study Area is located in the Stratford outwash plain, on the western Housatonic River valley floor. The surficial deposits immediately underlying the Study Area are mapped as Stratford outwash sediments and artificial fill (Flint, 1968). A review of boring logs indicates that the geology and description of unconsolidated deposits are consistent with those described for the region (Appendix B). One minor additional surficial deposit located within the Study Area, which is not indicated on the surficial geologic map, is a minor peat and organic-rich silt lens that was logged at SB-425 from 15.5 to 18.0 feet below grade. The thickness of the overburden materials ranges from zero along the bedrock exposures to the west of the Study Area, to 62 feet below grade in the northeastern portion of the Study Area (at SB-423).

On March 24, 1999, a water level round was conducted in 164 overburden and bedrock wells located within the OU2 Study Area, which includes the OU4 Study Area. The measurements from applicable shallow overburden wells were used to construct the water table elevation map for the Study Area (Figure 3-5).

Estimated groundwater flow directions for the Study Area are presented as arrows on the water table contour map (see Figures 3-5). In general, the shallow overburden groundwater flow direction within the Study Area is toward the east- southeast toward the former Raymark Facility. Further definition of the groundwater flow direction for the Study Area will be presented in the OU2 Groundwater RI Report.

The water table is located in bedrock at MW-308B, west of the Study Area and at MW-216B, north of the Study Area. The water table is located in overburden materials at the remainder of the well locations in and surrounding the Study Area. The depth to the water table varies across the Study Area but generally mimics the surface topography. Maximum depth to the water table is along the western edge of the property where it exceeds 20 feet. The minimum depth to the water table of approximately 5 feet occurs in the northern area of the ballfield at SB-429. Based on a comparison of the fill thickness and water table elevations from March 1999, it is estimated that approximately 70 percent of the fill is above the water table and 30 percent is saturated below the water table.

### **3.4            Surface Water Hydrology**

The Study Area is located within the Housatonic Main Stem Regional Drainage Basin. Long Island Sound receives the area's entire surface drainage via the Housatonic River. The Housatonic River is tidally influenced 11 miles upstream of the mouth of Ferry Creek, as far up as the Derby Dam in Derby, Connecticut. The Housatonic River is listed as Class SC/SB water, Coastal Marine Surface Waters, with an average discharge of 3,400 cubic feet per second at its mouth, based on an average discharge (Weston, 1993).

Historic photographs of the property indicate the presence of two small water bodies. These were subsequently filled and today there are no longer any surface water bodies located within the Study Area.

Surface runoff of precipitation is controlled by the topography of the site, which is discussed in Section 3.1 and can be seen in Figure 1-2. In general, the precipitation that does not contribute to groundwater within the property runs off the site toward the east and Frog Pond Lane and East Main Street where the Town of Stratford drainage system controls the discharge into the Housatonic River.

The University of Connecticut has estimated peak storm event precipitation rates for the State of Connecticut (University of Connecticut, 1999). Peak precipitation accumulation rates are listed below for the Study Area.

- 2-year storm = approximately 1.28 inches/hour
- 25-year storm = approximately 2.0 inches/hour
- 100-year storm = approximately 2.5 inches/hour

Using the 100-year storm peak precipitation rate of 2.5 inches/hour, the runoff peak flow rate for the entire Study Area would be 30,063 ft<sup>3</sup>/hour or 224,887 gallons/hour.

### **3.5        Meteorology**

A National Oceanographic and Atmospheric Administration (NOAA) Climatological Station is located at the Bridgeport - Sikorsky Airport, approximately 2 miles from the Study Area. Data from this station have been used to describe the climate in the area, as provided below.

The Town of Stratford, Fairfield County, Connecticut, is located in a temperate-humid climate characterized by highly changeable weather, with daily and annual temperature variations strongly influenced by Long Island Sound and the Atlantic Ocean. The area is characterized by monthly, seasonal, and annual variations in temperature, wind speed, direction, and precipitation amounts, which is in the form of both rain and snow.

On average, July is the warmest month, with an average temperature of 73.7 degrees F. Average wind speed and direction for the warmest months is 10.2 miles per hour (mph) from the southwest. The coldest month is January, with an average temperature of 28.9 degrees F. Average wind speed and direction for the colder portion of the year is 13.3 mph from the northwest.

Normal annual precipitation for the area is 41.66 inches of rain, with a regular distribution throughout the year. Snow fall typically occurs between November and April, with a mean of 25 inches per year (NOAA, 1993).



## **4.0 NATURE AND EXTENT OF CONTAMINATION**

This section summarizes analytical data from field investigations performed during the RI to characterize the nature and extent of chemical contamination in the Study Area. A discussion of the potential sources of contamination affecting the Study Area (see Figures 1-1 and Figure 1-2) is provided in Section 4.1. Section 4.2 presents an overview of the types of chemical compounds detected in the Study Area, and a brief discussion relating the presence of these chemicals to past operations at the former Raymark Facility. Section 4.3 discusses the background concentrations developed for comparison with the Study Area values. Comparisons of analytical results for Study Area environmental media to background results and available benchmark criteria are provided in Section 4.4. Analytical data used to evaluate the nature and extent of contamination are presented in Appendix C.

Although the evaluation of the nature and extent of contamination includes discussions of all the major classes of chemical contaminants analyzed, the RI focuses on chemical characterization of three of the major contaminants (lead, PCBs, and asbestos) associated with past activities at the former Raymark Facility. Figures depicting the presence and concentrations of these contaminants are included to support the analyses in Section 4.4.

### **4.1 Potential Sources of Contamination**

The major source of contamination at the Study Area is the disposal of Raymark soil-waste materials. Waste materials were brought from the former Raymark Facility and used as fill to develop a ballfield. Additional sources of contamination that may have contributed to soil contamination in the Study Area include dumping of unknown wastes, and disposal of drums and debris from sources other than the Raymark Facility (Weston, 1993). Disposal of these materials has resulted in contaminant levels in Study Area soils that exceed those in background location samples.

## **4.2            Overview of Chemical Compounds Detected**

Brief descriptions of the major classes of chemical contaminants detected in the soil in the Study Area, and the common industrial uses of these chemicals, are provided in Sections 4.2.1 through 4.2.7. Section 4.2.8 and Table 4-1 provide a summary of the specific chemicals known to have been stored, handled, or used at the Raymark Facility during its operation that may have contributed to contamination of the Study Area. A discussion of the terminology used for evaluating the analytical data collected in the Study Area is provided in Section 4.2.8.

### **4.2.1            Volatile Organic Compounds (VOCs)**

The VOCs detected in environmental samples collected from the Study Area may be separated into three major groups: chlorinated hydrocarbons, aromatic hydrocarbons, and ketones. Many of these VOCs are organic solvents commonly used in industrial processes to degrease parts; to prepare metal surfaces prior to painting, coating, or bonding; as constituents of paint thinners and resins; and to extract organic compounds from materials. Additionally, some of the detected VOCs are common components of gasoline and petroleum fuels.

VOCs used at the Raymark Facility consisted mainly of chlorinated hydrocarbons, aromatic hydrocarbons, and ketones used as organic solvents. Organic solvents were also used in various capacities at the former Raymark Facility.

### **4.2.2            Semivolatile Organic Compounds (SVOCs)**

The SVOCs detected in environmental samples collected from the Study Area may be separated into three major groups: phenolic compounds, polynuclear aromatic hydrocarbons (PAHs), and phthalates. Other SVOCs detected include only a few isolated compounds. SVOCs are common constituents of various industrial products. Phenolic compounds are typically associated with fuels, coal, and petroleum products, and are used

to manufacture friction materials. PAHs are common components of coal tar (bitumen and asphaltic tars), petroleum products (motor and fuel oil), and combustion by-products. Phthalates are typically used as plasticizers in the manufacture of synthetic materials.

SVOCs used at the Raymark Facility included phenolic compounds, naphthalene, and phthalates. Phenolic resins were used in manufacturing friction materials, and were mixed with asbestos to manufacture brake pads and linings at the former Raymark Facility.

#### **4.2.3 Pesticides**

Pesticides are typically used to control the presence or population of unwanted insects in both residential and commercial areas, as well as to prevent crop destruction in agricultural settings. Pesticide formulations may include chlorinated and organophosphorus varieties.

Pesticides may have been used at the Raymark Facility to control insect populations. However, no documentation of use has been identified.

#### **4.2.4 Polychlorinated Biphenyls (PCBs)**

The PCBs detected in the environmental samples collected from the Study Area consisted primarily of Aroclor 1262 and Aroclor 1268. PCBs are extremely stable chemicals with a wide range of physical properties. They have been historically used in plasticizers, adhesives, lubricants, heat transfer fluids, and as dielectric fluids in transformers and capacitors. Aroclor 1262 and Aroclor 1268, specifically, are commonly used as plasticizers in synthetic resins. Aroclor 1268 is also commonly used as a wax extender and plasticizer in rubbers.

No information has been provided directly by the Raymark Facility documenting the specific use of PCBs as part of their manufacturing process. However, EPA has reported that PCBs were used in manufacturing brake linings. The Raymark Facility was also known as having used and/or manufactured both rubber (gasket materials) and resins

(phenolic resins in brake linings). Aroclor 1262 and Aroclor 1268 may have been used as plasticizers in these materials. Aroclor 1262 and 1268 were both identified in soils and groundwater at the former Raymark Facility.

#### **4.2.5           Metals**

Numerous metals were detected in the environmental samples collected from the Study Area. Metals are naturally occurring components of soil and/or localized mineral deposits and occur as a result of decomposition of weathered bedrock. Metals may also be introduced into the environment through various industrial activities including disposal of waste materials or process sludges, and fugitive emissions from various thermal or combustion processes.

Barium, copper, lead, tin, and zinc were the primary metals used at the Raymark Facility to fabricate various brake and friction materials. Each was detected at elevated concentrations in the Study Area.

#### **4.2.6           Asbestos**

Asbestos was detected in sediment and soil samples collected from the Study Area. Asbestos is a group of magnesium silicate minerals that contains varying quantities of iron and calcium silicates. Because of its non-combustible and heat-resistant properties, asbestos was commonly used to manufacture brake linings, gaskets, fireproof fabrics, roofing materials, and electrical and heat insulation, and as a reinforcing agent in rubber and plastics.

Asbestos-containing materials were a primary component in the products manufactured at the Raymark Facility. Asbestos fibers were mixed with phenolic resins to manufacture brake pads and linings. Asbestos was also used to manufacture friction materials (clutches and transmission plates) and gaskets.

#### **4.2.7 Chemical Compounds Used or Handled at the Raymark Facility**

A number of chemical compounds and materials were handled, stored, and/or used in manufacturing processes at the Raymark Facility during its operation. A list of these chemicals, presented in Table 4-1, was developed from information provided in the *RCRA Facility Investigation Report* (ELI, 1995) and the RCRA Part A application (August 15, 1980). A Part B application was drafted but never filed for the Raymark Facility.

#### **4.2.8 Terminology for Evaluating Analytical Data**

In order to evaluate the nature and extent of contamination in the Study Area, and determine its relationship to past disposal and operational practices at the Raymark Facility, data generated from analysis of field samples are typically compared to background concentrations and reviewed in relation to the data collected throughout an entire area of concern. Definitions of the terms used to describe and compare the contaminant concentrations in the following sections are as follows:

- elevated - detected at a concentration either greater than its corresponding average background concentration, or greater than a specified concentration if no average background concentration was determined
- high, higher, or highest - detected in one location at one or more orders of magnitude greater than at another location
- comparable - detected in one location at the same order of magnitude as another location
- low or lower - detected in one location at one or more orders of magnitude less than another location

Discussion about the development of background concentrations is provided in Section 4.3.

Definitions of terms related to sampling depths and media are as follows:

- surface samples – Samples collected at depths of up to 2.0 feet below bgs
- subsurface samples – Samples collected at depths of greater than 2.0 feet bgs

### **4.3        Background Concentrations**

To assess whether chemicals (organic compounds and metals) detected in Study Area environmental media are related to or are the result of past disposal activities or releases, it is necessary to compare the analytical results for on-site samples with those obtained from locations that are unlikely to have been affected by past site activities. In this way, on-site chemical presence may be attributed to naturally occurring sources (such as metals in soils), contamination that is pervasive in an area, i.e., pesticides in agricultural communities, lead in urbanized areas, etc., or to site-related occurrences.

For purposes of evaluating the nature and extent of contamination, the average background concentrations serve as a basis to identify elevated contaminant concentrations in samples collected within the Study Area (see Section 4.4). If contaminant concentrations exceeded the average background concentrations, a contaminant source was suspected and the contaminant concentrations were considered "elevated." Because of the industrial nature of the Stratford area, contaminant concentrations below the average background levels are not considered representative of an affected area and, therefore, did not warrant further discussion in the evaluation of nature and extent. However, it is important to note for the human health risk assessment

that background concentrations were not used to eliminate chemicals of potential concern (COPCs) except in the case of non-carcinogenic metals.

Contaminants not analyzed in the background samples were compared to other screening values such as the Connecticut Pollutant Mobility Criteria (CT PMC) for GB Aquifers or the Connecticut Direct Exposure Criteria (CT DEC) for Residential Soil.

Background soil samples were collected from various locations around the Town of Stratford from schools, day care centers, and recreational areas. The samples were analyzed for pesticides/PCBs and metals. Metals results from 34 of 39 sample locations and pesticides/PCBs results from 27 of 37 sample locations were determined to be representative of background conditions. Because of variability in the analytical data and/or heterogeneity of the samples, average background concentrations were developed by averaging the numerical data from samples deemed representative of background conditions. (The numerical averages were calculated as the arithmetic average of the detected concentrations and half the detection limits for those compounds/analytes reported as undetected.) The summary statistics for background concentrations for pesticides, PCBs, and metals are presented in Table 4-2. Background soil samples were not analyzed for VOCs or SVOCs.

#### **4.4            Nature and Extent of Contamination in Soil**

To evaluate the soil analytical results, the data were compared with average background concentrations for pesticides, PCBs, and metals. The CT DEC and the CT PMC were also used as screening values in the RI to help identify potential chemicals of concern that would be addressed in the baseline human health risk evaluation, or to identify chemicals that may pose potential threats to groundwater quality. If both criteria exist for a particular contaminant, the CT PMC is used because it is typically more conservative. In the case of metals and PCBs, the CT DEC is used because the CT PMC requires Synthetic Precipitation Leaching Procedure (SPLP) or Toxicity Characteristic Leaching Procedure (TCLP) results. None is available for the Study Area.

In addition, the EPA has adopted the following criteria specifically for sites where Raymark wastes are known to have been deposited:

Lead – 400 mg/kg

Asbestos – 1 percent

Total PCBs – 1 ppm or 1,000 ug/kg

These are the primary contaminants associated with Raymark-type waste and when two or three of the three contaminants are present, a property was selected for cleanup to levels below these criteria. Analytical results for lead, asbestos, and PCBs at the ballfield was compared to the EPA criteria as well as background, CT PMC and CT DEC, if available.

Summary statistics and a comparison to available benchmarks described above are presented in Table 4-3 for surface soils and Table 4-4 for subsurface soils. The presence in surface soils of total PAHs, PCBs, lead, arsenic, barium, zinc, and asbestos are depicted on Figures 4-1a, 4-2a, 4-3a, 4-4a, 4-5a, 4-6a, and 4-7a, respectively. The presence of those same contaminants in subsurface soils is depicted on Figures 4-1b through 4-7b. These compounds have been selected as chemicals of potential concern regarding risk to human health. Copper and chromium (Figures 4-8a and b and 4-9a and b) were also evaluated in detail as chemicals that may pose potential threats to groundwater.

#### **4.4.1 VOCs in Soils**

The extent of VOC contamination in surface and subsurface soils is discussed below.

##### Surface Soils

VOCs were analyzed for at eight sample locations concentrated in the southern portion of the Study Area. Only four VOCs were detected (2-butanone, acetone, carbon disulfide, and



chlorobenzene). All concentrations were low; none exceeded the CT PMC for soils, which are listed in Table 4-3.

#### Subsurface Soils

The VOCs detected in surface soils were also detected in subsurface soils. Concentrations of 2-butanone and acetone were comparable in surface and subsurface soils, but concentrations of carbon disulfide and chlorobenzene were slightly higher in subsurface soils. The aromatic hydrocarbons chlorobenzene, benzene, and total xylenes were detected at concentrations exceeding the CT PMC at SB-425 and SB-427, which are located in the southwestern portion of the Study Area. The highest concentrations of benzene (7,700  $\mu\text{g/kg}$ ) and total xylenes (43,000  $\mu\text{g/kg}$ ) were detected at 16 feet bgs to 18 feet bgs at SB-425. At SB-427, high benzene and chlorobenzene concentrations (1,100  $\mu\text{g/kg}$  and 47,000  $\mu\text{g/kg}$ , respectively) were detected from 10 feet to 12 feet bgs. The CT PMC for chlorobenzene, benzene and total xylenes are 2,000  $\mu\text{g/kg}$ , 200  $\mu\text{g/kg}$ , and 19,500  $\mu\text{g/kg}$ , respectively. The southwest portion of the Study Area was reportedly used as a dumping area for brush, leaves, and street sweepings by the Stratford Department of Public Works (DPW). Drums and jugs of waste oil have also been found in this portion of the property (EAI, July 26, 1990; Weston, January 1993). This may constitute the source of some VOC contamination, particularly compounds found in petroleum products like benzene. No other VOCs were detected at concentrations exceeding CT PMC, and none of the contaminants described above was detected in groundwater at the Study Area, indicating that soils at the Study Area are not likely contributing to VOC contamination in groundwater at this time.

#### 4.4.2 SVOCs in Soils

The extent of SVOC contamination in surface and subsurface soils is described below.

##### Surface Soils

Semi-volatile organic compounds (SVOCs) are distributed throughout the southern portion of the Study Area at low concentrations. In general, SVOCs are not abundant at the Study Area, as evidenced by the low frequencies of detection presented in Table 4-3. The SVOCs detected consist of a number of PAHs, phthalates, and a few other compounds. Almost all soil SVOCs were detected at concentrations below the CT PMC. Dibenzo(a,h)anthracene (CT PMC =  $0.96 \mu\text{g/kg}$ ), indeno(1,2,3-cd)pyrene (CT PMC =  $9.6 \mu\text{g/kg}$ ), and N-nitroso-di-n-propylamine (CT PMC =  $1.0 \mu\text{g/kg}$ ) exceeded CT PMC in every sample where the analyte was detected. Figure 4-1a shows the total PAH concentrations in surface soils. Total PAHs were highest at SB-425 and ranged from  $579 \mu\text{g/kg}$  to  $3,842 \mu\text{g/kg}$ s with an average concentration of  $1,800 \mu\text{g/kg}$ . Similar concentrations were widely distributed throughout the limited number of samples collected throughout the Study Area.

##### Subsurface Soils

Similar to the distribution in surface soils, SVOCs are widely distributed throughout subsurface soils in the southern portion of the Study Area (Figure 4-1b). PAHs are the primary SVOCs detected. Total PAH concentrations range from  $22 \mu\text{g/kg}$  at MW-401 to  $68,820 \mu\text{g/kg}$  at SB-421 from 4 feet to 6 feet bgs. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene are the primary contributors to the high total PAH concentrations. Each compound was detected above CT PMC, which are listed in Table 4-4. High concentrations of SVOCs were found as deep as 18 feet bgs at SB-427.

This comparison with the screening levels indicates that elevated SVOCs presence is very limited in Study Area surface soils, but higher SVOC concentrations exist in subsurface

soils in the Study Area from 2 feet to 18 feet bgs. The higher concentrations of total PAHs were not detected in any one portion of the Study Area in surface soils. In subsurface soils, the higher concentrations appear to be focused in the southern and western portions of the Study Area. No SVOCs were detected in groundwater samples collected from the Study Area, suggesting that Study Area soils are not currently contributing to SVOCs presence in groundwater. Potential threats to human health risks due to SVOCs, particularly PAHs, are evaluated in the risk assessment.

#### **4.4.3 Pesticides in Soils**

The extent of pesticide contamination in surface and subsurface soils is described below.

##### Surface Soils

Pesticides have been detected in Study Area soils at low concentrations and their presence is sparse, as indicated by the low frequencies of detection depicted in Table 4-3. Few pesticides (heptachlor epoxide, alpha chlordane, gamma chlordane, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT) were detected at concentrations greater than average background. All locations where 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT exceeded average background are located in the ballfield playing area (except SB-24 along the railroad track). Concentrations of 4,4',-DDE and 4,4'-DDT exceeded CT PMC (21  $\mu\text{g/kg}$  for both compounds) in half of the samples analyzed. 4,4'-DDD, endrin, and endrin ketone concentrations also exceeded CT PMC, 21  $\mu\text{g/kg}$ , 0.0  $\mu\text{g/kg}$  and 0.0  $\mu\text{g/kg}$ , respectively. It is likely that pesticides were applied to the ballfield area for insect control during the years when the ballfield was in full use. The pesticides detected in surface soils were each detected at low concentrations in groundwater from one overburden on-site well (MW-402S), but none exceeded MCLs (where numbers are available). It is not likely that pesticides in Study Area soils are acting as a major contributor to pesticide contamination of groundwater. Pesticides were also detected in groundwater samples from wells located upgradient of the Study Area.

### Subsurface Soils

The pesticides detected in surface soils were also detected in subsurface soils. Concentrations of 4,4'-DDE and gamma chlordane were slightly higher in subsurface soils. In addition to the pesticides detected in surface soils, aldrin, alpha-BHC, beta-BHC, delta-BHC, dieldrin, encosulfan I and II, and endrin aldehyde, were detected at concentrations greater than average background. Gamma chlordane was detected above average background most frequently. Detected concentrations ranged from 0.039  $\mu\text{g/kg}$  at SB-401 from 14 feet to 16 feet bgs, to 220  $\mu\text{g/kg}$  at SB-425 from 2 feet to 4 feet bgs. Concentrations of other pesticides exceeding average background concentrations were detected throughout the Study Area and at all subsurface depths. Fifteen of the twenty pesticides detected in subsurface soils were measured at concentrations exceeding CT PMC, which are listed in Table 4-4.

#### **4.4.4 PCBs in Soils**

The extent of PCB contamination in surface and subsurface soils is described below. A comparison to the CT DEC is used for screening purposes. No SPLP or TCLP results are currently available for the Study Area, so a comparison to CT PMC is not provided.

### Surface Soils

One hundred eleven surface soil samples were analyzed for PCBs (Figure 4-2a). The range of detected concentrations of total Aroclors was 182.1  $\mu\text{g/kg}$  – 35,149  $\mu\text{g/kg}$ ; the highest concentration was found at BF021 behind the first base bleachers. Elevated PCB concentrations (greater than the EPA criterion for Raymark-type waste of 1,000  $\mu\text{g/kg}$ ) were sporadic except along the western Study Area boundary (at BF005, BF006, BF008, and BF020). Elevated concentrations were also detected in three samples from the playing field (RMF C + 50, RMF C + 200, and RMF C + 300) and at SB402B in the southeast corner of the property. No Aroclor concentrations greater than 1,000  $\mu\text{g/kg}$  were detected in the southwest portion of the Study Area. Aroclor 1262 and Aroclor 1268 were detected most frequently, while Aroclors 1016, 1242, and 1248 were each detected once. Concentrations of Aroclor

1016 and 1248 were less than the EPA criterion for Raymark-type waste and the CT DEC of 1,000  $\mu\text{g/kg}$ . Aroclor 1242 was detected at BF020 at 3,000  $\mu\text{g/kg}$ , which is above the CT DEC. No Aroclors were detected in background samples.

### Subsurface Soils

No subsurface samples were collected where surface soil sample results showed highest Aroclor concentrations. Similar to the surface soils, Aroclor 1262 and Aroclor 1268 were detected most frequently, and had the highest concentrations. Refer to Figure 4-2b for the distribution of total Aroclors in subsurface soils in the Study Area. Aroclor 1262 was detected in 46 of 59 samples and detected concentrations ranged from 7.2  $\mu\text{g/kg}$  (SB-422 from 2 feet to 4 feet bgs) to 110,000  $\mu\text{g/kg}$  (SB-426 from 6 feet to 8 feet bgs). Aroclor 1268 was detected in 49 of 59 samples and detected concentrations ranged from 10  $\mu\text{g/kg}$  (SB-423 from 6 feet to 8 feet bgs) to 230,000  $\mu\text{g/kg}$  (SB-426 from 6 feet to 8 feet bgs). The maximum concentration of each Aroclor was detected at SB-426 from 6 feet to 8 feet bgs. Aroclors 1232 and 1242 were detected at relatively low concentrations (110  $\mu\text{g/kg}$  to 210  $\mu\text{g/kg}$ ) in samples from borings SB-421 and SB-424 at depths ranging from 4 feet to 14 feet bgs. Aroclors were not detected in background samples. Subsurface soil samples were not collected from the areas with the highest surface soil PCB contamination (behind the first base bleachers and along the western Study Area boundary or in the ballfield), so the vertical extent of PCB contamination in those areas is undefined.

However, based on high concentrations in surface soils in these areas, it is likely that the subsurface soils also have elevated concentrations of PCBs. The depth to bedrock in these areas is relatively shallow. The highest subsurface soil concentrations of total Aroclors are found throughout the Study Area. In eight of 15 borings, subsurface soil concentrations exceeded 25,000  $\mu\text{g/kg}$  (25 ppm).

Aroclors 1262 and 1268 are the two Aroclors detected in samples collected from the soils at the former Raymark facility, and it is likely that their presence at the Study Area is due to the presence of Raymark-type soil-waste/fill materials.

Sections 4.4.5 to 4.4.6,  
5.0, and 6.0  
(pages 62-119)  
are available  
in a separate file (size: 4.7 MB)

**[Click here to view.](#)**

Sections 6.5 to 6.7.4, 7.0 to 8.0,  
References, and Tables  
(pages 120-176)  
are available  
in a separate file (size: 4.0 MB)

**[Click here to view.](#)**

Figures  
(pages 177-192)  
are available  
in a separate file (size: 4.4 MB)

**[Click here to view.](#)**



Figures  
(pages 193-204)  
are available  
in a separate file (size: 5.0 MB)

**[Click here to view.](#)**

Appendix A and  
Appendix B Well Construction Logs  
(pages 205-246)  
are available  
in a separate file (size: 3.4 MB)

**[Click here to view.](#)**

Appendix B Boring Logs  
(pages 247-289)  
is available  
in a separate file (size: 3.8 MB)

**[Click here to view.](#)**

Appendix B Boring Logs,  
Well Construction Logs and Test Pit Logs  
(pages 290-350)  
is available  
in a separate file (size: 4.1 MB)

**[Click here to view.](#)**